Catalogue of American Amphibians and Reptiles.

Price, Andrew H. 1990. *Phrynosoma cornutum*

Phrynosoma cornutum (Harlan) Texas Horned Lizard

Lacerta tapajaxin: Barton, 1806:69. Nomen nudum (see Remarks).

Agama cornuta Harlan, 1824 (1825):299. Type-locality, "Plains of Arkansas", restricted to Fort Riley, Geary Co., Kansas by Smith and Taylor (1950a, b). Holotype not designated, collector and date of collection unknown (see Remarks).

Phrynosoma bufonium Wiegmann, 1828:367. Type-locality, "Surinam", *ex errore*, restricted to Los Nogales, Sonora, Mexico by Smith and Taylor (1950a). Holotype lost, collected by Graf von Sack, date of collection unknown.

Tapaya cornuta: Cuvier, 1829:37.

Phrynosoma cornutum: Gray, 1831:45. First use of combination.

Lacerta orbicularis: Griffith and Pidgeon, 1831:216 (part).

Phrynosoma harlanii: Wiegmann, 1834:54.

Phrynosoma cornuta: Holbrook, 1838:55.

Phrynosoma orbiculare: Holbrook, 1838:61 (part).

Phrynosoma (Tropidogaster) cornutum: Fitzinger, 1843:79.

Phrynosoma (Tropidogaster) bufonium: Fitzinger, 1843:79.

Phrynosoma planiceps Hallowell, 1852 (1854):178. Type-locality, "western Texas, near the Rio Grande", restricted to El Paso, El Paso Co., Texas by Smith and Taylor (1950a). Holotype, Academy of Natural Sciences in Philadelphia (ANSP) 8641, an adult female, collected by Dr. Woodhouse, date of collection unknown (not examined by author).

Phrynosoma cornutum planiceps: Boulenger, 1885:246.

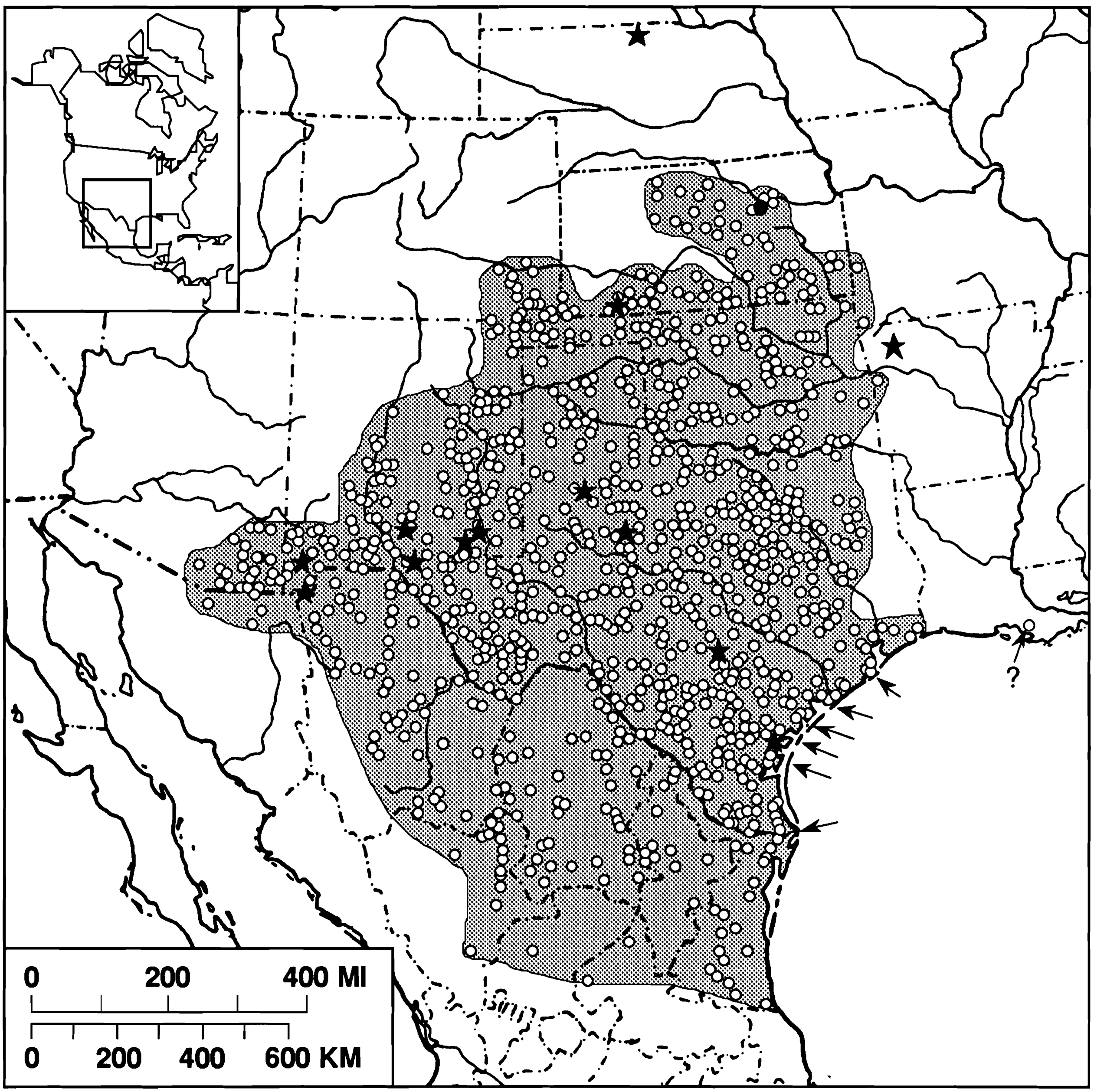
Phrynosomus cornutus: Herrera, 1899:7.

Tropidogaster cornutus: Ruthven, 1907:547.

Tropidogaster bufonium: Ruthven, 1907:547.

Phrynosoma brevicornis Boulenger, 1916:537. Type-locality, "[Galveston, Galveston County], Texas". Holotype, British Museum (Natural History) 1946.8.10.44 (formerly BMNH 1916. 7.20.2), an adult male, collected by J. S. Huxley, date of collection unknown (examined by author).

Eumecoides hibbardi Taylor, 1941:173. Type-locality, "Rexroad For-



Map. The solid circle marks the restricted type-locality, open circles other records. Arrows indicate occurrences on coastal barrier islands. Stars mark fossil localities. See text regarding the uncertainty of the eastern range boundary.

mation, Upper Pliocene, Loc. 2, about 16 miles southwest of Meade, Meade County, Kansas." Holotype, Kansas Univ. Mus. Vert. Paleon. 5099, collected by Claude W. Hibbard and party, 1936 (not examined by author). See Remarks.

Eumecoides mylocoelus Taylor, 1941:174. Type-locality, "Rexroad Formation, Upper Pliocene, Loc. 2, about 16 miles southwest of Meade, Meade County, Kansas." Holotype, Kansas Univ. Mus. Vert. Paleon. 5115, collected by Claude W. Hibbard and party, 1936 (not examined by author). See Remarks.

• **Content.** No subspecies are recognized.

• **Definition**. *Phrynosoma cornutum* is a large, sexually-dimorphic (adult males and females 60-100 mm and 70-120 mm snout-vent length, respectively) member of the "northern radiation" species group (*sensu* Montanucci, 1987). The head is as wide as long, and slopes steeply in lateral profile from the nasal area to the lip. The external nares are situated within the canthal line and enter vertically. There is a single pair of well-developed, widely-spaced, acute occipital spines and three pairs of temporal spines; the former are usually at least twice the length of the latter. The temporal spines are situated at or above the level of the eye. There is a single small interoccipital spine. Each supraorbital ridge terminates posteriorly in a short, thick superciliary spine. There are 3 groups of lateral gular spines on each side. The tympanum is distinct and not covered by scales. A single row of spinose chinshields enlarging anteroposteriorly occurs along each margin of the lower jaw, and is separated from the infralabials by 1 or 2 scale rows. A postrictal scale is absent. There is a single longitudinal row of enlarged gular scales which lie flat against the throat on either side. There are two complete rows of enlarged lateral abdominal fringe scales on each side of the body, and one such row on either side of the tail. The tail is relatively long, at least twice the length of the head. The ventral scales are non-mucronate and weakly keeled. The scales on the anterior surfaces of the limbs are large, pointed, and strongly keeled. The dorsal body scales are highly heterogeneous in size and shape; the largest of these are modified as short, vertical spines with 4 distinct keels, the 4th keel on the posterior surface at the base of the scale.

The ground color of brown, reddish-brown, yellow, tan or gray varies with geographic location and prevailing substrate type; individual lizards are cryptic in their natural habitats. Color hues are often intensified in both sexes during the breeding season. There is a distinct middorsal light line. A series of longitudinal dark-brown dorsal blotches occurs on either side of the midline; each blotch is edged with white, cream to yellow-orange posteriorly. The dorsal blotches are most distinct next to the midline, where each serves as a focus for a vertical spine. The lateral series may fuse to produce a pattern of undulating dark bars. There is a large brown patch on either side of the neck behind the occipital and temporal spines. Two or three dark bars radiate from the eye, one posteriorly to the temporal spines and the remainder anteriorly and/or vertically to the line of the mouth. Other dark markings on the head may be indistinct, but consist of transverse bars between the eyes and between the superciliary spines, and laterally on each side between the latter and the occipital spines.

• **Diagnosis**. A single pair of occipital spines, a single row of enlarged gular scales, two complete rows of lateral abdominal fringe scales, keeled non-mucronate ventral scales, enlarged modified dorsal scales with 4 distinct keels, and the absence of a postrictal scale distinguish *Phrynosoma cornutum* from all congeners.

• **Descriptions.** The most comprehensive are in Holbrook (1838), Cope (1900), Van Denburgh (1922), Smith (1946), Reeve (1952), and Montanucci (1987). Other descriptions are those of Girard (1852), Cuesta-Terrón (1932), Detrie (1950), Conant (1975), Behler and King (1979), Sherbrooke (1981), Stebbins (1954, 1985), and Garrett and Barker (1987). Cavazos (1951) described the karyotype as 2N = 36 (12 macrochromosomes + 24 microchromosomes) whereas Robinson (*in* Gorman, 1973) described it as 2N = 34 (12 metacentric macrochromosomes + 22 microchromosomes).

• **Illustrations.** Color photographs are in Cochran and Goin (1970), Behler and King (1979), Switak (1979), Martof et al. (1980), Bigony (1981), Hammerson (1982), Garrett and Barker (1987), Johnson (1987), and Obst et al. (1988). Sherbrooke (1981) presented a series of color photographs, including habitat, horns piercing the throat of a snake, and blood-spraying behavior. Black and white photographs are in Ruthven (1907), Boulenger (1916), Van Denburgh (1922), Schwardt (1938), Smith (1946), Milne and Milne (1950), Anderson (1965), Guibé (1970), Nietzke (1980), and Collins (1982). A black and white photograph of a hatchling is in Blaney and Kimmich (1973). Bogert (1959) provided black and white photographs documenting color change in response to changes in body temperature. Cahn (1926) provided a black and white photograph of an excavated nest, and Milne and Milne (1950) one of a female with eggs. Reeve (1952), Oelrich (1954), and Montanucci (1989) provided black and white photographs of the skull, fossil elements, and jaw, respectively. Baur (1984) has a black and white photograph of a hybrid with *Phrynosoma coronatum*. Clark (1971) provided a black and white photograph of a brand on the ventral surface. Ruthven (1907) and Switak (1979) provided habitat photographs.

A color drawing is in Conant (1975); black and white drawings in Girard (1852), Cope (1900), and Stebbins (1954, 1985). Drawings of fossils are in Etheridge (1958) and Holman (1979), and of the digestive tract in Parsons and Cameron (1977). Detrie (1950) provided several drawings of the skull. Cavazos (1951) illustrated the karyotype. Photomicrographs of various portions of the reproductive tracts of both sexes are in Jarvis (1908), Mellish (1936), Melampy and Cavazos (1954), and Cuellar (1966). Marshall and Smith (1930) provided photomicrographs of cross-sections through the kidney, and Anderson (1960) and Roberts and Schmidt-Nielsen (1966) provided electronmicrographs of the same organ. Photomicrographs of the digestive tract, motor nerve endings, and skin melanophores are in Parsons and Cameron (1977), Cole (1955) and Redfield (1918), respectively.

• **Distribution.** *Phrynosoma cornutum* ranges from central Kansas, extreme southwestern Missouri, and the southeastern corner of Colorado southward and westward throughout most of Oklahoma and Texas (including coastal barrier islands in the Gulf of Mexico), the southeastern half of New Mexico and the southeastern corner of Arizona to the Mexican states of Sonora (extreme northeastern corner), Chihuahua and Durango (east of the Sierra Madre Occidental massif), Coahuila, Nuevo León, Tamaulipas, San Luis Potosí, and Zacatecas. The species occupies a variety of open desert and grassland habitats from sea level to 1830 m. Soils may vary from deep, pure sands along the Gulf coast, sandy-loams of alluvial fans and around playas and playa-lakes, to coarse gravels, conglomerates and desert pavements of bajadas and mesa tops. Vegetation associations occupied include shortgrass prairie, mesquite-grasslands, shrublands (catclaw/tobosa, mesquite-huisache-blackbrush), desert scrub (mesquite-creosote, yucca-mesquite-*Ephedra*, *Flourensia-Gutierrezia-Ephedra*-mesquite), and desert grasslands. Desert populations cycle in abundance, possibly following similar cycles of their primary prey, harvester ants of the genus *Pogonomyrmex*.

The natural eastern boundary of the species' range may never be known with certainty (see below and Comment). All of the Missouri and Arkansas records have been questioned (Anderson, 1965; Dowling, 1956, 1957), although some occur within contiguous vegetation communities that are occupied in Kansas and Oklahoma. *P. cornutum* is probably not native to Louisiana (Dundee and Rossman, 1989), although an old record (USNM 1897) from St. Mary's Parish falls within an extension of the Gulf Coastal Plain vegetation community in Texas which supports the species. All other records are from towns and cities within pre-settlement forest communities. Some of the Texas records north of the Gulf Coastal Plain and east of the Trinity River may represent fragmented natural populations within the ecotone between the blackland prairies and oak-hickory, pine-oak and pine woodlands, but many others are known or suspected introductions.

The widespread introduction of *Phrynosoma cornutum* outside of its native range has been documented over 115 years as follows: Alabama (Mount, 1975; Marion and Dindo, 1980; Carey, 1983; additional museum records); Arizona (museum records); Arkansas (Yarrow, 1882; Dellinger and Black, 1938; Webb and Packard, 1961); Colorado (Hammerson, 1984); the District of Columbia (Yarrow, 1882); Florida (Allen and Neill, 1955; Carr and Goin, 1955; King and Krakauer, 1966; Bartlett, 1967; Auth, *in litt.*; additional museum records); Georgia (Martof, 1956); Illinois (Smith, 1961); Indiana (museum records); Kansas (Collins, 1982); Kentucky (museum records); Louisiana (Frierson, 1927; Webb and Packard, 1961; additional museum records); Michigan (Davis, 1941; additional museum records); Mississippi (Cook, 1966; additional mu-

seum records); Missouri (Anderson, 1965; additional museum records); Nebraska (museum records); North Carolina (Gray, 1941; Settle, 1989); South Carolina (Martof et al., 1980); Tennessee (museum records); Texas (Strecker and Williams, 1928; Webb and Packard, 1961); Virginia (Yarrow, 1882); Wyoming (museum records). Some of the Florida and South Carolina populations have persisted for at least 40 and 20 years, respectively, based on specimen collection records.

• **Fossil Record.** Fossils have been reported from the Pliocene of Kansas (Taylor, 1941; Oelrich, 1954; Etheridge, 1960) and Texas (Rogers, 1976); Pleistocene of Arkansas (Gilmore, 1928; Holman, 1980), Kansas (Etheridge, 1958; Holman, 1979), Nebraska (Holman, 1972), New Mexico (Holman, 1970; Harris, 1987, 1989), and Texas (Holman, 1968, 1969; Van Devender *in* Montanucci, 1987); Pleistocene/Holocene of New Mexico (Brattstrom, 1964; Rickart, 1977; Van Devender and Worthington, 1977); and Holocene of New Mexico (Applegarth, 1979) and Texas (Raun and Laughlin, 1972).

• **Pertinent Literature.** General reviews or discussions of life-history parameters are in Cuesta-Terrón (1932), Smith (1946), Milne and Milne (1950), Stebbins (1954), Pianka and Parker (1975), and Sherbrooke (1981). Milne and Milne (1950) provided an annotated bibliography of literature to date; other bibliographic compendia are in Smith and Smith (1973, 1976) and Dixon (1987).

Comprehensive ecological studies that centered on predictions and tests of optimal foraging theory are those of Whitford and Bryant (1979) and Munger (1984a, b). Less in-depth ecological characterizations can be found in Winton (1916), Jameson and Flury (1949), Minton (1958 [1959]), Worthington (1972), Barbault and Grenot (1977), Whitford and Creusere (1977), Switak (1979), Barbault and Maury (1981), Creusere and Whitford (1982), and Hammerson (1982). Munger (1984c, 1986) discussed home range determination and predation, respectively, in a southeastern Arizona population. Thiollay (1981) presented data on predation by *Buteo* in Mexico. Strecker (1908b) noted a dead hawk found with an individual *P. cornutum* lodged in its trachea, and Anderson and Ogilvie (1957) reported the presence of this species in a collection of owl pellets. Other ecological notes are in Lowe (1947), Milstead et al. (1950), Bonn and McCarley (1953), Fouquette and Lindsay (1955), Domínguez et al. (1974), Clark et al. (1982), Best et al. (1983), deVore (1985), and Tanner (1987). Davis (1941) and Milstead and Tinkle (1969) presented dietary data, and Montanucci (1989) discussed the relationship of trophic morphology to diet. Schmidt et al. (1989) reported blood factors conferring enhanced immunity against ant venom. Hutchison and Larimer (1960) discussed physiological ecology.

Brattstrom (1965) reported body temperature values. Thermoregulation was studied by Heath (1962, 1965), Regal (1967), Ballinger and Schrank (1970), Kour and Hutchison (1970), and Prieto and Whitford (1971). Hall (1922) and Potter and Glass (1931) discussed desiccation and respiration during hibernation, respectively. Dawson and Poulson (1962) presented data on oxygen capacity of the blood. Data on plasma electrolyte levels and glomerular filtration rates of the kidney are in Roberts and Schmidt-Nielsen (1966) and Dantzler and Braun (1980), respectively. The effects of gonadotropins on the reproductive system are in Mellish (1936), Mellish and Meyer (1937), Potter and Brown (1941[1942]), and Burns and Richards (1974). Leichner (1970) reported on thyroid endocrinology. Redfield (1916, 1918) discussed hormonal control of color change.

General notes on behavior are in Cope (1900), Strecker (1908b), Winton (1916, 1917), Fitch (1981), and Creusere and Whitford (1982). Whitford and Whitford (1973) and Peslak (1986) discussed social interactions between males, and Carpenter (1967) discussed male courtship behavior. Lynn (1965) gave a display action-pattern graph. Hewatt (1937) and Milne (1938) reported on mating behavior, while the former and Givler (1922), Cahn (1926), and Ramsey (1956) discussed nest-excavation and oviposition behaviors. Sherbrooke (1987) discussed defensive postures and Sutton (1922) described a specific defensive encounter with a roadrunner. Behavior associated with blood ejection is reported by Lambert and Ferguson (1985). Meyer (1966) discussed drinking behavior and Williams (1959) noted nocturnal activity.

Fitch (1970, 1985) presented a review of data on reproduction and a brief discussion of geographic variation in reproduction, respectively. Ballinger (1974) was a detailed study of reproduction, including data on clutch size, geographic variation, and sexual activity seasons of both sexes. Additional data are in Parker (1973), Howard (1974), Vitt (1977), and Vitt and Congdon (1978). Ballinger and Clark (1973) and Vitt (1978) gave caloric values for eggs and carcasses of females. Jarvis (1908) discussed germ-cell segregation and Cavazos (1951) discussed spermatogenesis.

Morphology has been studied as follows: general osteology (Cope, 1892; Etheridge, 1964; Presch, 1969; Montanucci, 1987); skull (Detrie, 1950; Lemire, 1985); scleral ossicles (Gugg, 1939; Presch, 1970); inner ear (Hamilton, 1964); dentition (Hotton, 1955; Olson et al., 1986); taste buds (Schwenk, 1985); olfactory system (Crosby and Humphrey, 1939); thyroid anatomy (Lynn et al., 1966); neural anatomy (Northcutt, 1968); motor endplates (Cole, 1955); digestive tract (Parsons and Cameron, 1977); circulatory system (Heath, 1966); urogenital system (Brooks, 1906; Cordier, 1928); female reproductive anatomy (Crowell, 1932; Cuellar, 1966); cloacal glands (Whiting, 1969); and kidney (Marshall and Smith, 1930; Anderson, 1960).

Reeve (1952) presented a taxonomic history of the species and he along with Etheridge (1964), Presch (1969) and Montanucci (1987) discussed morphological aspects in the context of phylogenetic analyses of the genus. Burt (1932) discussed the taxonomic status of *Phrynosoma brevicornis*. Biogeographical notes are in Mosauer (1932), Bogert and Oliver (1945), Morafka (1977), Lambert and Reid (1981), and McCoy (1984). Range maps are in Webb (1970), Conant (1975), Tanner (1975), Morafka (1977), and Stebbins (1985); county of distribution maps are in Collins (1982), Dixon (1987), and Johnson (1987). Dessauer et al. (1962) and Masat and Dessauer (1968) presented biochemical data, and Guttman (1971) reported intraspecific variation in heterozygosity values of hemoglobins. Melampy and Cavazos (1954) discussed the distribution of lipids in the testis. Notes on embryology are in Givler (1922) and Hubert (1976). Parasites are discussed by Harwood (1932), Hughes et al. (1941), Thompson and Huff (1944a, b), Lee (1955), and Mathewson (1979), and parasitology is reviewed by Babero and Kay (1967). Clark (1971) discussed marking techniques and Brown and Lucchino (1973) reported a specimen of record size. Baur (1984, 1986) reported on hybrids with *P. coronatum* and on longevity, respectively.

• **Remarks.** Harlan (1824(1825)) described *Agama cornuta* on the basis of two stuffed specimens in the collection of the Academy of Natural Sciences in Philadelphia. These specimens (possibly ANSP 8642-3) are missing, and lack catalog annotations (Malnate, *in litt.*). Holbrook (1838) attributed a third specimen to the type-series, but provided no additional details. Thomas Jefferson, according to both authors, was apparently responsible for procuring the first specimen of this species which, according to Holbrook (1838), was brought to him alive by Lewis and Clark and then given by Jefferson to the Museum of the Philosophical Society of Philadelphia. Holbrook (1838) credited Benjamin S. Barton, M.D., who named it *Lacerta tapajaxin*, with the first formal description of the species. Barton (1806), in the work referred to, allied the name to Linnaeus' *Lacerta orbicularis*, a senior synonym of *Phrynosoma orbiculare*, but deferred a full description to a paper that "will be published in the second part of the sixth volume of the American Philosophical Transactions." That paper (Barton, 1809) is clearly a description of a specimen of *Ambystoma maculatum*. The confusion is compounded by Barton (1806), who briefly discussed his specimen therein under the paragraph heading "amphibiology" and who stated that it spent much time "torpid", ate nothing, and when active was capable of subsisting for months without nourishment other than that received "from an atmosphere loaded with moisture."

Taylor (1941) described the fossil genus *Eumecoides*, and its constituent species *E. hibbardi* and *E. mylocoelus*, based on a single dentary for each. He referred the genus, with some doubt, to the Scincidae. Etheridge (1960), benefitting from subsequent discoveries of numerous lizard fossils from the Kansas Pliocene, determined that both *hibbardi* and *mylocoelus* are fossil *Phrynosoma cornutum*.

• **Etymology.** The name *cornutum* (L., "horned") refers to the distinctive spinose architecture of the head.

• **Comment.** *Phrynosoma cornutum* has virtually disappeared from Texas east of a line from Fort Worth through Austin and San Antonio to Corpus Christi on the Gulf Coast, areas where the species has historically been widespread and abundant (Edwards, 1896; Strecker, 1902, 1908a, 1922, 1926, 1929b; Strecker and Williams, 1927; Peterson, 1950; Ramsey, 1956; Hampton, 1975). This decline has been linked, without substantiation, in a direct cause-

and-effect relationship with the spread of the introduced fire ant, *Solenopsis invicta*. The indiscriminant use of broadcast insecticides to combat the fire ant may have been detrimental to *P. cornutum*, either directly or through elimination of its natural prey base. Pat implications of commercial exploitation and highway mortality as additional factors (Bigony, 1981) remain unsatisfactory, and obscure the real reasons behind this decline. *Phrynosoma cornutum* has also declined in abundance and/or become localized where formerly common in portions of northcentral Texas and the Texas Panhandle (Strecker, 1910, 1929a; Bonn and McCarley, 1953; Fouquette and Lindsay, 1955), as well as parts of Oklahoma. These areas have not yet been successfully colonized by *Solenopsis invicta*, but are subject to heavy agricultural use and habitat alteration.

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Andrew H. Price, Texas Natural Heritage Program, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, TX 78744.

Primary editor for this account, Jaime D. Villa.